

3A3. Direct Iron Ore Smelting Reduction Process (DIOS)

Research and development: Japan Coal Energy Center; and Japan Iron and Steel Federation

Period: 1988-1995 (8 years)

Technology Overview

1. Overview

The Direct Iron Ore Smelting Reduction Process (DIOS) directly uses noncaking coal in a powder or granular form, and iron ore without the use of coke or a sintering process, which are normally required in blast furnace processes. The noncaking coal is directly fed to a smelting reduction furnace, while the iron ore is preliminarily reduced before being fed to the furnace, thus producing molten iron.

2. Features

1. Possibility of utilizing inexpensive raw materials and fuel (noncaking coal, in-house dust, etc.)
2. Low operating cost
3. Responds flexibly to variations in production rate
4. Compact and small incremental investment
5. Stable, high-quality supply of iron source available
6. Effective use of coal energy
7. Easy co-production of energy (co-generation)
8. Low environmental load (low SOx, NOx, CO₂, dust generation, no coke oven gas leaks)

4. Research and development progress

Table 1 Research and development progress

Fiscal year	1988	1989	1990	1991	1992	1993	1994	1995
Core technology study								
Pilot plant test				Construction			Test operation	

1) Core technology study (FY1988-FY1990)

Core technologies necessary for the construction of the pilot plant were established. These core technologies include an increase in the thermal efficiency of a smelting reduction furnace (SRF), the technology to be integrated with a preliminary reduction furnace (PRF), the molten slag discharge technology, and the scale-up of an SRF.

2) Pilot plant test (FY1993-FY1995)

1. The possibility of directly using powder, granular ore, and coal was confirmed, and necessary equipment specifications were determined.

3. Results of study

A feasibility study was undertaken on the installation of a new commercial blast furnace plant and of DIOS in a waterfront area. Considering its superiority to the blast furnace process as described below, the feasibility of DIOS can be demonstrated for a 6,000 ton molten iron model production facility (annual production of 2 million tons).

1. Investment cost reduced by 35%.
2. Molten iron production cost decreased by 19%.
3. Coal consumed, 730-750 kg per 1 ton of molten iron production, equivalent to that of the blast furnace process.
4. Net energy consumption decreased by 3 to 4%.
5. CO₂ emissions in the iron making process decreased by 4 to 5%.

2. With various raw materials, the equipment and operating specifications to achieve high thermal efficiency, as an alternative to the blast furnace, were determined.

3. Technology for water-cooling the furnace body was established. A conceptual design and an economic evaluation (FS) for commercial facilities was conducted. The conditions of the facilities and of the operations to prove the superiority versus the blast furnace, as shown in the results of the research, was clarified.

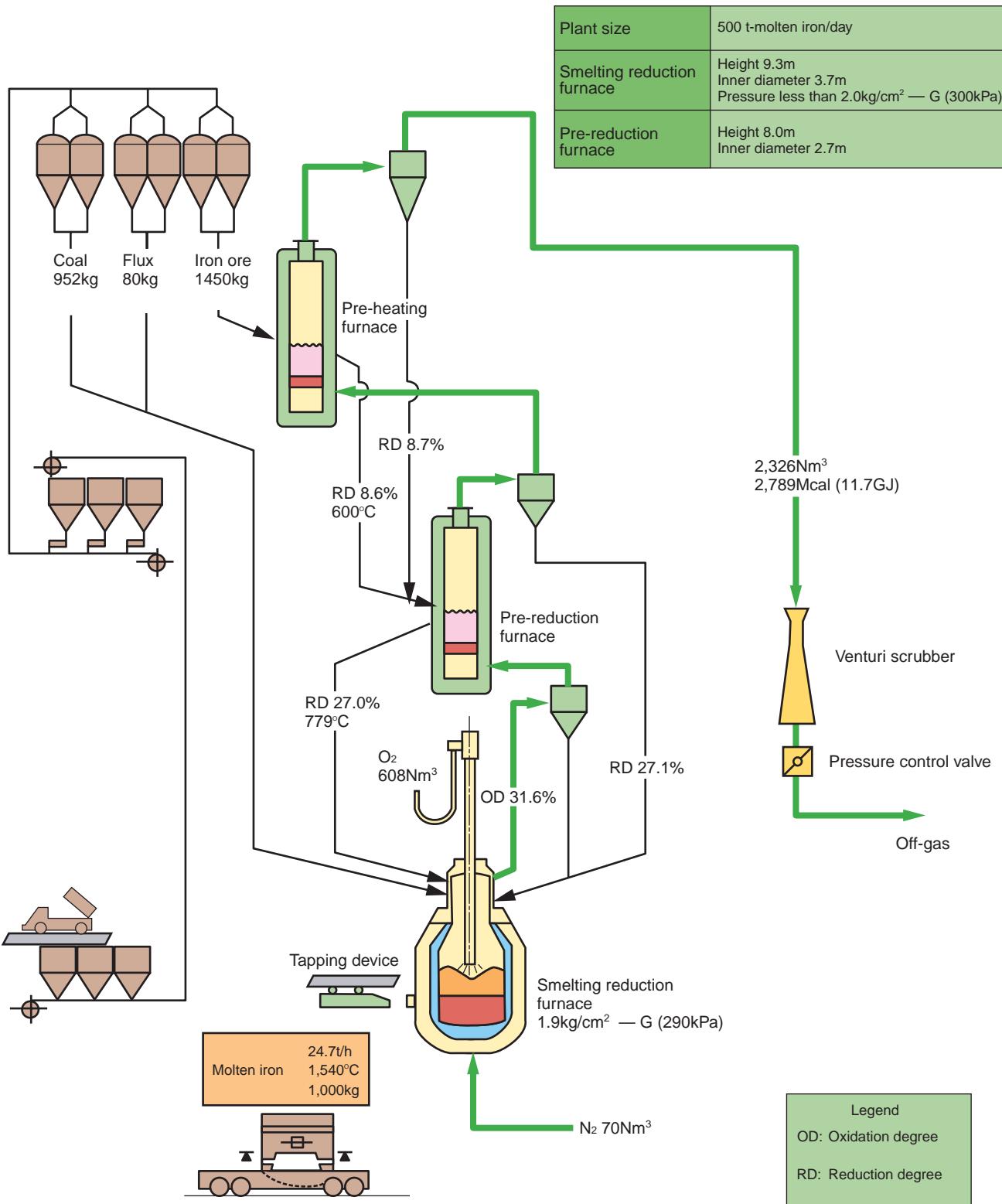


Fig. 1 Process flowchart for DIOS pilot plant (per 1,000kg of molten iron)